FORM PTO-1390 (Rev 5-93) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: **ZAHFRI P335US**

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U S APPLICATION NO (if known, see 37 C F R 1.5): 09/856728

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/09231	**November 27, 1999**	**December 4, 1998**

TITLE OF INVENTION

ELECTROMAGNETIC HYSTERESIS UNIT

APPLICANT(S) FOR DO/EO/US

Rudolf SCHNEIDER and Stefan UNSELD

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ■ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ■ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. ■ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ■ has been transmitted by the International Bureau. (PCT/IB/308 mailed **15 June 2000**).
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ■ A translation of the International Application into English (35 U.S.C. 371(c)(2)) is attached.
7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ■ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ■ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ■ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 with PTO FORM 1449.
12. ■ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
13. ■ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ■ Other items or information:
    - ■ Preliminary Examination Report
    - ■ Annexes to Pre. Ex. Rep.
    - ■ International Search Report
    - ■ German Novelty Search Report
    - ■ 4 copies of citations
    - ■ Form PCT/IB/308
    - ■ International Publ. No. **WO 00/35067** (Face page only)
    - ■ Copy of Request
    - ■ 4 sheets of formal drawings
    - ■ Abstract
    - ■ German Language Specification
    - ■ Marked-Up Version of Amended Specification

PATENT & TRADEMARK OFFICE

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date **May 24, 2001** in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number **EL469354896US** addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Anthony G. M. Davis
(typed or printed name of person mailing paper)

(signature of person mailing paper)

17. ■ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): JC18 Rec'd PCT/PTO 24 MAY 2001		
Search Report has been prepared by the EPO or JPO $860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)). $710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	860	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	0	

Claims	Number Filed	Number Extra	Rate		
Total Claims	14-20 =	0	x $18.00	0	
Independent Claims	2-3 =	0	x $80.00	0	
Multiple dependent claim(s) (if applicable)			+ $270.00	0	
			TOTAL OF ABOVE CALCULATIONS =	0	
Reduction by 1/2 for filing by small entity, if applicable. **Applicant claims Small Entity Status**. (Note 37 CFR 1.9, 1.27, 1.28).				0	
			SUBTOTAL =	860	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	0	
			TOTAL NATIONAL FEE =	0	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property			+	40	
			TOTAL FEES ENCLOSED =	900	
				Amount to be: refunded	$
				charged	$

a. ■ A check in the amount of $ **900.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 04-0213 in the amount of $____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-0213 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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05/24/01

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Rudolf SCHNEIDER and Stefan UNSELD
Serial no.	:	
For	:	ELECTROMAGNETIC HYSTERESIS UNIT
Docket	:	ZAHFRI P335US

BOX PCT
The Commissioner of Patents and Trademarks
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

By way of preliminary amendment, please amend the above identified application as set forth below.

In the Specification:

Please cancel paragraphs 2-4, 14, 15, 24 and 32 of the specification, in their entirety, in favor of a clean form of paragraphs 2-4, 14, 15, 24 and 32 of the specification as follows. Also accompanying this response is a copy of the original paragraphs of the specification which show the addition(s) (by underlining, shading and bold) and the deletion(s) (by strikeout) to the canceled specification paragraphs. Please enter the replacement specification paragraphs into the record of this case.

In the Claims:

Please cancel original claims 1-14, as well as any Chapter II amended claims, in favor of new claims 15-23 as follows.

[002] FIELD OF THE INVENTION

[003] The invention relates to an electromagnetic hysteresis unit.

[004] BACKGROUND OF THE INVENTION

[014] The problem on which the invention is based is to improve in the slip operation the brief and also the permanent thermal load of a hysteresis unit.

[015] SUMMARY OF THE INVENTION

[024] BRIEF DESCRIPTION OF THE DRAWING(S)

[032] DETAILED DESCRIPTION OF THE INVENTION

15. (NEW) An electromagnetic hysteresis unit (1, 23) having a magnetic north pole (4) around an axis of rotation (14), at a distance in a peripheral direction (15) from a south pole (5), alternating with the north and south poles, is in a magnet body (2, 3) which comprises a magnet coil (6) a movable hysteresis ring (16) having with slight play relative to said poles (4, 5) is connected with the rotor (17) peripheral surfaces of the north pole (4) and south pole (5) lie on the same circle and opposite to the same peripheral surface of said hysteresis ring (16), said hysteresis ring (16) surrounds said north pole (4) and said south pole (5), said poles are formed by pole fingers (4, 5) which departing from axial front walls of said magnet body (2, 3) are aligned upon each other and have from each other a greater distance than from said hysteresis ring (16) and said hysteresis ring (16) abuts a peripheral surface on said rotor (17), wherein said rotor (17) consists of a material of good heat conductivity in order to improve the heat conduction, that said magnet body (2, 3) is constructed in two parts and radially divided in the area of the magnet coil (6), that in said magnet body (2, 3) is supported by means of two ball bearings (10, 11) a continuous shaft (12) upon which said rotor (17) is firmly mounted, a collar (22) of said rotor (17) and a guard ring (21) mounted on said shaft (12) forming axial stops on which abuts a respective inner ring of one of said ball bearings (10, 11) while outer rings of said ball bearings abut on axial stops each formed by one of said two parts of said magnet body (2, 3) and that said magnet body is thick walled, the pole fingers being integrated in the two parts of said magnet body and tapering to their free end in axial direction relative to their radial and tangential expansion and tapering to a point relative to their radial expansion.

16. (NEW) The hysteresis unit (1, 23) according to claim 15, wherein said rotor (17) has cooling devices (18).

17. (NEW) The hysteresis unit (1, 23) according to claim 15, wherein said pole fingers (4, 5) overlap in peripheral direction (15).

18. (NEW) The hysteresis unit (1, 23) according to claim 15, wherein said magnet body (2) is disposed fastened on the housing and the current supply (7) is shifted through a free space (19) formed between said pole fingers (4, 5), said rotor being designed pot-shaped open on one side.

19. (NEW) The hysteresis unit (1, 23) with magnetic north pole (4) around an axis of rotation (14), at a distance in peripheral direction (15) from south pole (5), alternating with the pole, is situated in a magnet body (2, 3) which comprises a magnet coil (6), a movable hysteresis ring (16) having a slight play relative to said poles (4, 5) is connected with the rotor (17), wherein the peripheral surfaces of the north pole (4) and south pole (5) lie on the same circle and opposite to the same peripheral surface of said hysteresis ring (16), the hysteresis ring (16) surrounds said north pole (4) and said south pole (5), said poles being formed by pole fingers (4, 5) which, departing from axial front walls of said magnet body (2, 3) are aligned upon each other and have from each other a greater distance than from said hysteresis ring (16) and said hysteresis ring (16) abuts by a peripheral surface on said rotor (17), wherein said pole fingers (4, 5) are interconnected by a non-magnetizable material.

20. (NEW) The hysteresis unit (1, 23) according to claim 19, wherein said material, preferably brass, has good heat conductivity.

21. (NEW) The hysteresis unit (1, 23) according to claim 19, wherein said pole fingers (4, 5) are shrunk upon a connecting ring (27).

22. (NEW) The hysteresis unit (1) according to claim 19, wherein the intermediate spaces between said pole fingers (4, 5) are filled with a non-magnetizable filling component (28).

23. (NEW) The hysteresis unit (1, 23) according to claim 19, wherein it is designed as clutch by an outer part (25) with said pole finger (5) of said magnet body (2) being separated from the latter by a thin annular gap (26) and said second magnet body (3) sitting with a small gap (29) rotatably relative to said magnet body (2) upon a rotatable part to be coupled while the first magnet body (2) is mounted fastened on the housing.

REMARKS

Accompanying this response, please find replacement paragraphs and marked-up paragraphs of the specification which overcome some informalities noted in the specification on file. The undersigned avers that the enclosed replacement paragraph(s) of the specification do not contain any new matter.

Please enter the above before consideration of this application. With respect to the above newly entered claims, please note that the subject matter of the Chapter II amended claims is editorially revised and rewritten to bring that subject matter into conformity with the United States claim format.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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[001] ELECTROMAGNETIC HYSTERESIS UNIT

[002]

[003] According to the preamble of claim 1 the invention relates to an electromagnetic hysteresis unit.

[004]

[005] By electromagnetic hysteresis units will be understood hereinafter as hysteresis brakes and hysteresis clutches. The method of operation of the hysteresis units is based on a magnetic action force of poles that attract each other in the synchronous running and on a constant magnetic reversal of a magnetically, semi-hard material, namely, of a hysteresis ring in the slip operation.

[006] Unlike eddy-current clutches and brakes in hysteresis units, which are based on a different physical principle, the transmissible torque is, to a great extent, independent of the slip rotational speed.

[007] The best known design of such hysteresis units consists of a magnet body with one exciting coil each having an outer and inner pole ring with axially aligned superposed soft iron poles in the same number and spacing, wherein the outer poles are disposed offset in peripheral direction relative to the inner poles in the stationary state or during synchronous running by half a spacing and have an opposite polarization. In the radial intermediate space of the pole rings, the hysteresis ring can rotate as a thin-walled, bell-shaped part without contact.

[008] When magnet coils are traversed by current, a substantially radially oriented magnetic field generates between the poles of opposite polarity. But the pole off-set produces an alternatively tangential reorientation of the magnetic flow in the hysteresis ring and thus a permanent reverse magnetization of all elementary magnets when the hysteresis ring rotates relative to the magnetic body. Therefrom results a torque which depends only on the exciter flow. It can be regulated and controlled by adequately changing the exciting current. Such hysteresis units are known as clutch, e.g. from United States Patent No. 2,488,827. Here the hysteresis ring is disposed radially between two parts of a rotatable magnet body which parts are connected by a disc of non-magnetizable material.

[009] From DE 197 05 290 A1 is further known a hysteresis brake in which a hysteresis ring surrounds a closed magnetic ring of permanent magnetic material whose surface facing the hysteresis ring is provided with a plurality of poles embedded on the periphery and having alternatively opposite polarity. The magnetic ring is segmentally radially magnetized through and connected with a soft iron magnet body. The hysteresis ring rotates in an annular air gap between the magnet ring and an adjusting ring with slight radial play relative to the magnetic ring. The transmissible torque can be adjusted by an axial displacement of the adjusting ring.

[010] The hysteresis ring is, in general, made of a material having small wall thickness and connected with a rotating part. Opposite to this, the parts provided with a large mass, such as magnet coils, magnet body, etc., are connected with the housing. In the case of a hysteresis clutch, one part of the magnet body is formed by a rotor and a magnetic-flux guiding disc connected therewith which rotates with slight play relative to the magnet body.

[011] Because of the air gap between the hysteresis ring and the pole rings, the torque is contactlessly transmitted. Brakes produce both a brake torque in slip operation and a retaining torque in stationary state so that the decelerated part can also be kept in a decelerated position. Hysteresis clutches transmit torques both in synchronous running during which the coupled parts have the same rotational speed and in slip operation during which the parts to be coupled still have rotational speed difference. The transmissible torques depend on ly on the current in the exciting coil and can be continuously adjusted up to an admissible maximum value based on the type.

[012] The power loss resulting in the slip operation heats the thin-walled hysteresis ring very quickly. The heat can be removed only very deficiently, via the small material thickness of the hysteresis ring, to the adjoining parts in order to be eliminated therefrom by further heat conduction and convection. The admissible permanent slip power on one side and the briefly removable slip work on the other are thus very limited.

[013] Such hysteresis units are used, among others, for traction regulation for the processing of drawn endless products like wire, cable, rope, sheets, paper, threads, etc. They are also used for brake torque regulating systems and for a load simulation such as for test stands, ergometers, etc.

[014] The problem on which the invention is based is to improve in the slip operation the brief and also the permanent thermal load of a hysteresis unit. This is solved by the features of claim 1. Other developments result from the sub-claims.

[015]

[016] According to the invention the peripheral surfaces of the north poles and south poles lie on the same circle, the center of which lies on the axis of rotation. They also lie opposite the same peripheral surface of the hysteresis ring. Thereby the hysteresis ring is able to rotate on one peripheral surface at short distance from the magnets while on the other peripheral surface it is embedded in a rotor made of material having good heat conductivity which can also have cooling devices such as in the form of cooling ribs. It is thus ensured that the heat accumulated be thoroughly removed and that great slip torques can be transmitted for a long time.

[017] The hysteresis ring conveniently surrounds the north poles and the south poles so that it lies with the adjoining rotor parts on the outer periphery of the hysteresis unit. Thereby result, on one hand, large heat radiation surfaces and, on the other, the rotor generates in this area itself a great air movement which favors the convention. In the peripheral area of the rotor cooling ribs are conveniently disposed which can be aligned both axially and in peripheral direction and can be interrupted by slots.

[018] In one development of the invention, the poles are formed by pole fingers which, departing from axial front walls of the magnet body, are fitted upon each other and have between them a larger distance than from the hysteresis ring so that the magnetic flux leads from a north pole to a south pole via the hysteresis ring. The pole fingers can here advantageously overlap in peripheral direction.

[019] The pole fingers, which extend substantially axially, taper toward their free end in axial direction and/or in peripheral direction. Thereby material and weight are spared and a good magnetic flux obtained. In particular, the tapering in peripheral direction produces a very uniform distribution of the magnetic flux between adjacent pole fingers so that the hysteresis ring uniformly absorbs energy on its breadth and local temperature peaks are prevented.

[020] The magnet body can be easily produced with its pole fingers when it is divided in a radial plane, each separate part of the magnet body receiving the pole finger of one polarity. A centering ring reciprocally centers the two parts of the magnet body which are usually interconnected with screws,.

[021] To keep the rotating masses small, it is advantageous that the magnet body with the magnet coil be disposed fastened on the housing and to use a free space between the pole fingers for current supply. In combination with a pot-shaped rotor open on one side, current can be supplied without an expensive sliding ring arrangement subject to wear.

[022] To increase the stability of the pole fingers, the same as to prevent vibrations and flow noises, it is convenient that the pole fingers be interconnected by a non-magnetizable material. If the material, preferably brass, has good heat conductivity, it can, at the same time, serve uniformly to distribute the accumulated heat and remove it to the outside. The material can be advantageously introduced as filling composition in the intermediate spaces between the pole fingers or be formed by a connecting ring upon which the pole fingers are shrunk.

[023] When the hysteresis unit is designed as clutch, an outer part of the first magnet body is conveniently separated by an annular gap and connected with the second magnetic body via the non-magnetizable material. The rest of the first magnet body with the coil are mounted fastened on the housing while the second magnet body sits on a part to be coupled and is rotatably supported with a small gap relative to the first magnet body. A second part to be coupled is non-rotatably connected with the hysteresis unit which carries the hysteresis ring.

[024]

[025] Other advantages result from the description of the drawing that follows. An embodiment of the invention is shown in the drawing. The expert will conveniently regard the features also separately and make with them logical added combinations. In the drawing:

[026] Fig. 1 is a longitudinal section through a hysteresis brake;

[027] Fig. 2 is a section corresponding to the line II-II in Fig. 1;

[028] Fig. 3 is a partial development of a hysteresis ring and a few pole fingers according to Fig. 1;

[029] Fig. 4 is a longitudinal section through a hysteresis clutch wherein the upper half shows a design with connecting ring and the lower half a design with a filling compound;

[030] Fig. 5 is a partial development of a hysteresis ring and a few pole fingers according to Fig. 4, upper half; and

[031] Fig. 6 is a partial development of a hysteresis ring and a few pole fingers according to Fig. 4, lower half.

[032]

[033] The hysteresis unit shown is a hysteresis brake 1. It has a divided magnet body 2, 3 which comprises one magnet coil 6. The magnet body is divided in a radial plane. The two parts 2 and 3 thereof are centered relative each other by a centering ring 8 and interconnected by screws 9. The magnet body 2, 3 consists of soft iron and has on its outer periphery pole fingers 4, 5 which extend substantially axially and are alternatively integrated on the part 2 or part 3 of the magnet body.

[034] If the magnet coil 6 is supplied with current, via a current supply 7, the pole finger 4 form, in the embodiment shown, a north pole on part 2 of the magnet body while the pole finger 5 form south poles on part 3 of the magnet body. The magnet body 2, 3 is mounted fastened to the housing. Thereby the current supply 7 can be easily shifted through one of the free spaces 19 formed between the pole fingers 4, 5.

[035] In the magnet body 2, 3 is supported, by ball bearings 10, 11, a shaft 12 which rotates around an axis of rotation 14. The shaft 12 carries on its ends fitting keys 13 by which rotating parts (not shown in detail) can transmit a torque to the shaft 12. On the shaft 12 sits firmly on a pot-shaped rotor 17 open on one side in which is embedded a hysteresis ring 16 made of magnetically semi-hard material. The shaft 12 is axially fixed between a collar 22 on the rotor 17 and a guard ring 21 embedded in the shaft 12. The rotor 17 itself is made of material having good heat conductivity and can support cooling devices in the form of cooling webs 18 in order to improve the heat conduction and convection. The cooling webs 18 can extend in peripheral direction or axially and have notches and/or bores.

[036] Fig. 2 shows that the distance between the pole fingers 4, 5 is greater than the distance between the pole fingers 4, 5 and the hysteresis ring 16. Thereby the hysteresis ring 16 is flowed through according to the magnetic flux 20. During a relative movement of the hysteresis ring 16 in peripheral direction 15 toward the magnet body 2, 3, the polarization fo the elementary magnetic zones produced in the hysteresis ring 16 is reverse whereby a considerable torque can be transmitted. The torque primarily depends on the intensity fo the current flowing through the magnet coil 6. As a result of the power loss in the slip operation which results from the reversal of polarization of the hysteresis ring 16, a great amount of heat accumulates in it. The amount of heat is, of course, removed via the rotor 17 and given off to the environment so that in comparison to known hysteresis units great torques can be transmitted in the slip operation without an overheating of the hysteresis brake having to be feared.

[037] According to Fig. 4, the hysteresis unit 23 is a clutch. It differs from the hysteresis unit 1 of Fig. 1 designed as a brake by the fact that the first magnet body 2, which is mounted fastened on the housing, has an outer part 25 which is separated by a narrow annular gap 26 from the other first magnet body 2. The outer part 25 is connected via a connecting ring 27 made of non-magnetizable material, preferably brass, with the second magnet body 3 by it being shrunk by its pole finger 4 and the second magnet body 3 by its pole finger 5 upon the connecting ring 27 (upper halves of Fig. 4 and Fig. 5). The connecting ring 27,

which can also be used in a hysteresis unit 1 according to Fig. 1, imparts to the hysteresis unit 23 a great stability and serves at the same time for better distribution and removal of heat.

[038] The second magnet body 3 sits upon a part to be coupled and is rotatably supported relative to the first magnet body 2 from which it is separated by an annular gap 26 and by a gap 29. The other part to be coupled is non-rotatably connected with rotor 17 in which the hysteresis ring 16 is embedded. The rotor 17 has on the outer periphery grooves 24 to enlarge the surface and thereby better to remove the heat. At the same time, the periphery of rotor 17 can be designed as belt pulley for a drive mechanism.

[039] In the variant according to the lower half of Fig. 4 and according to Fig. 6, the intermediate spaces between the pole fingers 4, 5 are filled with a non-magnetizable filling compound 28 which creates the connection between the outer part 25 of the first magnet body 2 and the second magnet body 3. The filling compound 28 is conveniently introduced in the intermediate spaces by a casting or sealing technique. As filling compound can be used, for example, a non-magnetizable metal like brass or also a plastic material.

Reference numerals

1 hysteresis unit
2 first magnet body
3 second magnet body
4 pole finger, north pole
5 pole finger, south pole
6 magnet coil
7 current supply
8 centering ring
9 screw
10 ball bearing
11 ball bearing
12 shaft
13 fitting key
14 axis of rotation
15 peripheral direction
16 hysteresis ring
17 rotor
18 cooling webs
19 free space
20 magnetic flux
21 guard ring
22 collar
23 hysteresis unit
24 groove
25 outer part
26 annular gap
27 connecting ring
28 filling compound
29 gap

Claims

1. Electromagnetic hysteresis unit (1, 23) with magnetic north poles (4) which around an axis of rotation (14), at a distance in peripheral direction (15) from south poles (5) and alternating them, is situated in a magnet body (2, 3) which comprises a magnet coil (6) wherein with slight play relative to said poles (4, 5), a moveable hysteresis ring (16) connected with the rotor (17) is provided, characterized in that the peripheral surfaces of the north poles (4) and south poles (5) lie in the same circle and opposite to the same peripheral surface of said hysteresis ring (16).

2. Hysteresis unit (1, 23) according to claim 1, characterized in that said hysteresis ring (16) surrounds said north pole (4) and said south pole (5).

3. Hysteresis unit (1, 23) according to any one of the preceding claims, characterized in that said poles are formed by pole fingers (4, 5) which, departing from axial front walls of said magnet body (2, 3), are aligned upon each other and have from each other a greater distance than from said hysteresis ring (16).

4. Hysteresis unit (1, 23) according to claim 3, characterized in that said pole fingers (4, 5) overlap in peripheral direction (15).

5. Hysteresis unit according to claim 4, characterized in that said pole fingers (4, 5) taper toward their free end in axial direction and/or in peripheral direction (15).

6. Hysteresis unit (1, 23) according to any one of the preceding claims, characterized in that said hysteresis ring (16) is embedded in said rotor (17) which consists of material having good heat conductivity.

7. Hysteresis unit (1, 23) according to claim 6, characterized in that said rotor (17) has cooling devices (18).

8. Hysteresis unit (1) according to any one of the preceding claims, characterized in that said magnet body (2, 3) is radially divided in the area of said magnet coil (6), both parts (2, 3) being centered relative each other and interconnected via a centering ring (8).

9. Hysteresis unit (1, 23) according to any one of the preceding claims, characterized in that said magnet body (2) is disposed fastened on the housing and the current supply (7) is shifted through a free space (19) formed between said pole fingers (4, 5), said rotor being designed pot-shaped open on one side.

10. Hysteresis unit (1, 23) according to any one of claims 3 to 9, characterized in that said pole fingers (4, 5) are interconnected by a magnetizable material.

11. Hysteresis unit (1, 23) according to claim 10, characterized in that said material, preferably brass, has good heat conductivity.

12. Hysteresis unit (1, 23) according to claim 10 or 11, characterized in that said pole fingers (4, 5) are shrunk upon a connecting ring (27).

13. Hysteresis unit (1, 23) according to any one of claims 10 to 12, characterized in that the intermediate spaces between said pole fingers (4, 5) are filled with a non-magnetizable filling component (28).

14. Hysteresis unit (23) according to any one of claims 10 to 11, characterized in that it is designed as clutch by an outer part (25) with said pole finger (5) of said magnet body (2) being separated from the latter by a thin annular gap (26) and said second magnet body (3) sitting with a small gap (29) rotatably relative to said magnet body (2) upon a rotatable part to be coupled while the first magnet body (2) is mounted fastened on the housing.

ELECTROMAGNETIC HYSTERESIS UNIT

ABSTRACT OF THE DISCLOSURE

The invention is based on an electromagnetic hysteresis unit (1, 23) with magnetic north pole (4) which are arranged to alternate with magnetic south pole (5) on a magnet body (2, 3) in a peripheral direction (15) about an axis of rotation (14) at a distance from the magnetic south poles (5). The magnet body (2, 3) comprises a magnet coil (6). A hysteresis ring (16) connected with a rotor (17) can be moved with a slight play in relation to the poles (4, 5). It is proposed that the peripheral surfaces of the north pole (4) and south pole (5) lie on the same circle and opposite the same peripheral surface of the hysteresis ring (16). Thereby is created a radial construction space for embedding the hysteresis ring (16) in the rotor (17) which consists of material of good heat conductivity and optionally for providing cooling ribs.

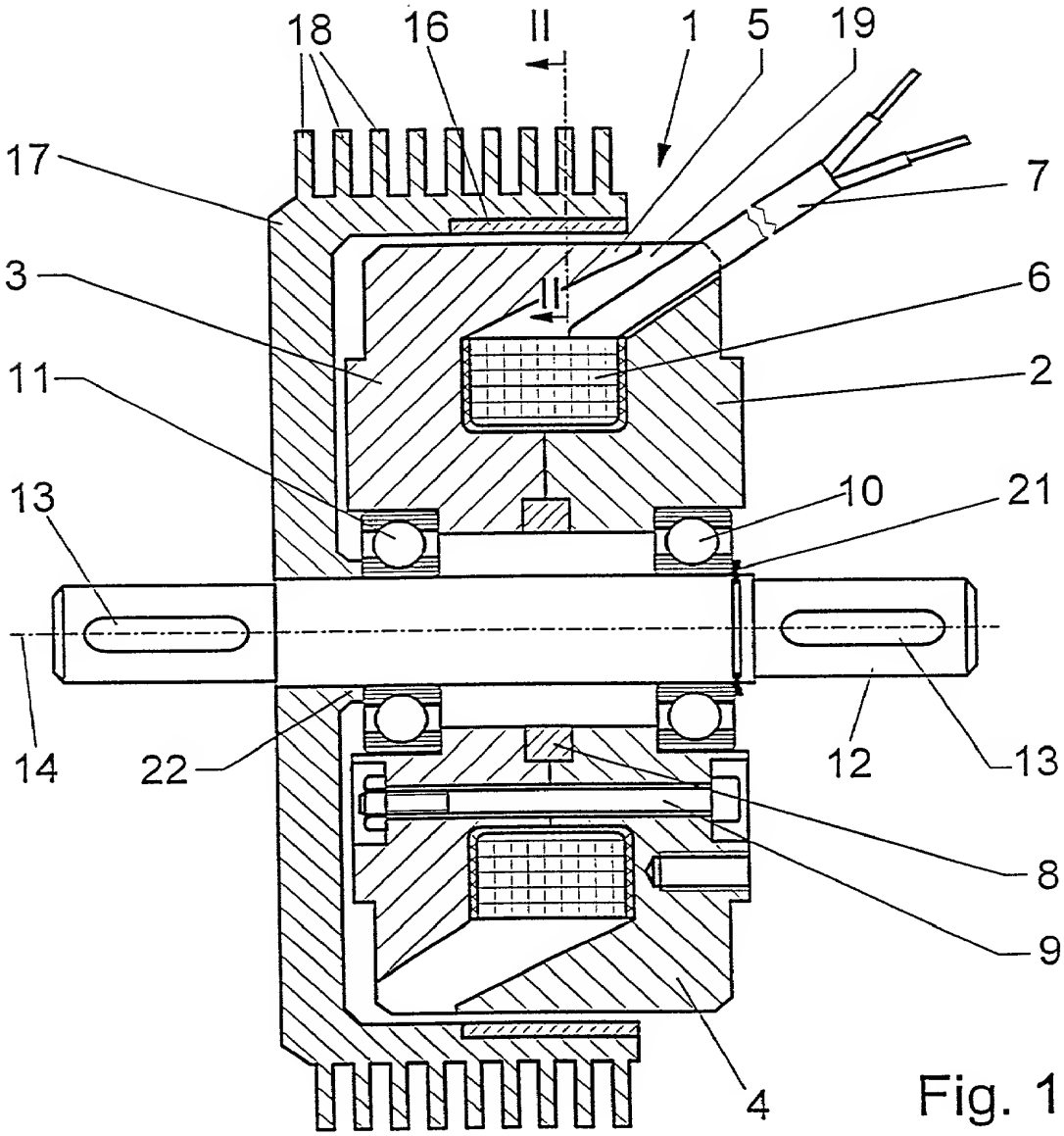

Fig. 1

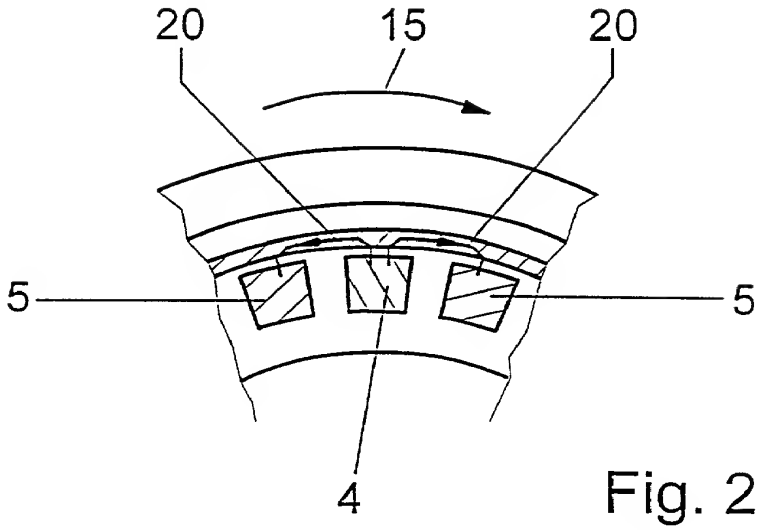

Fig. 2

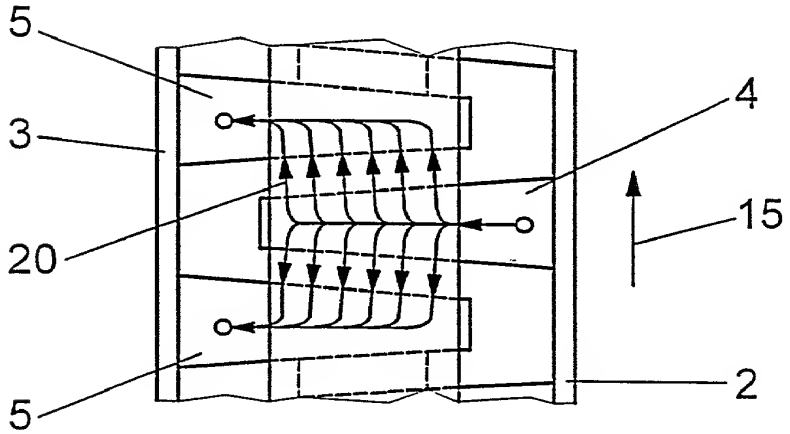

Fig. 3

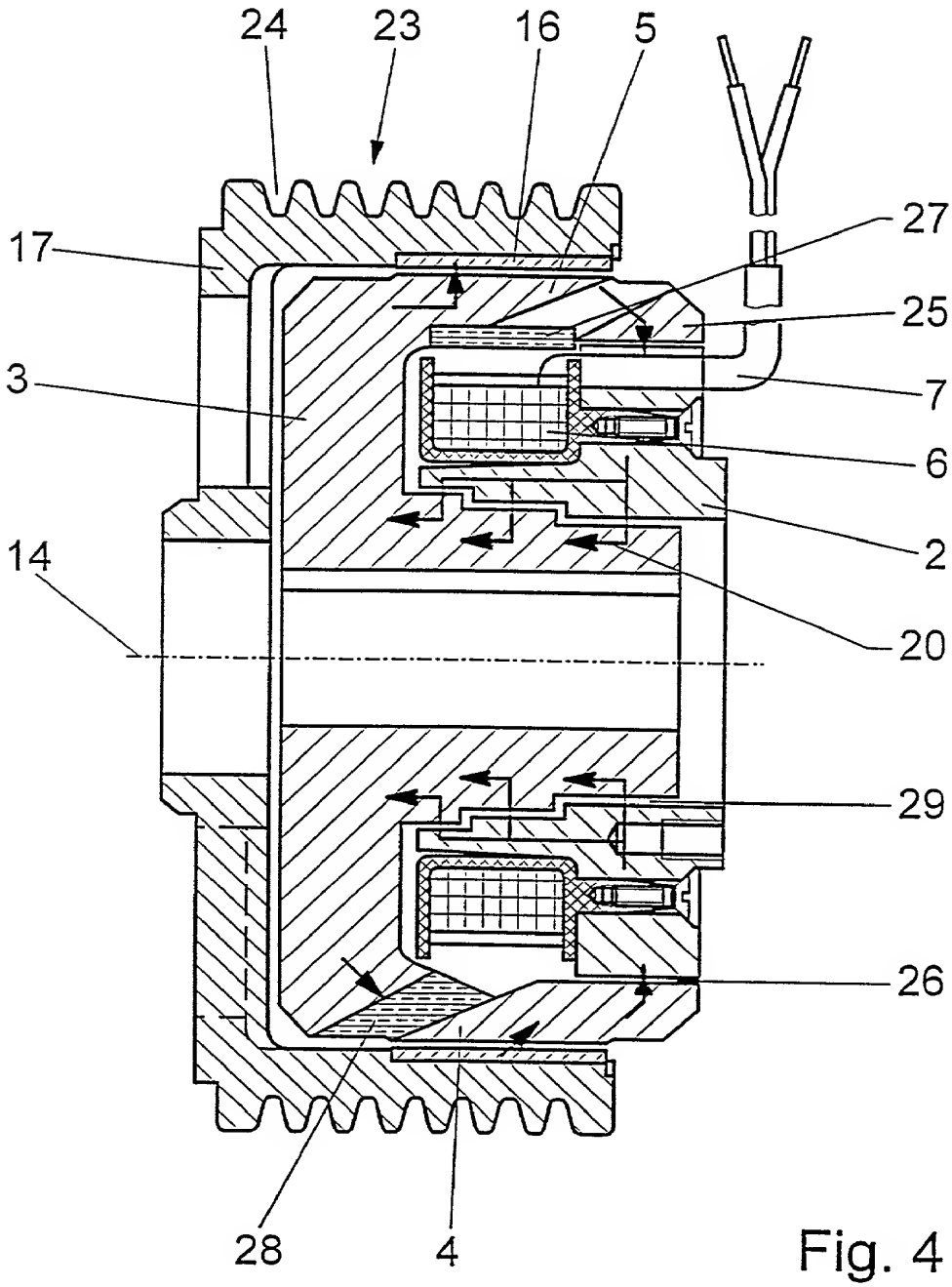

Fig. 4

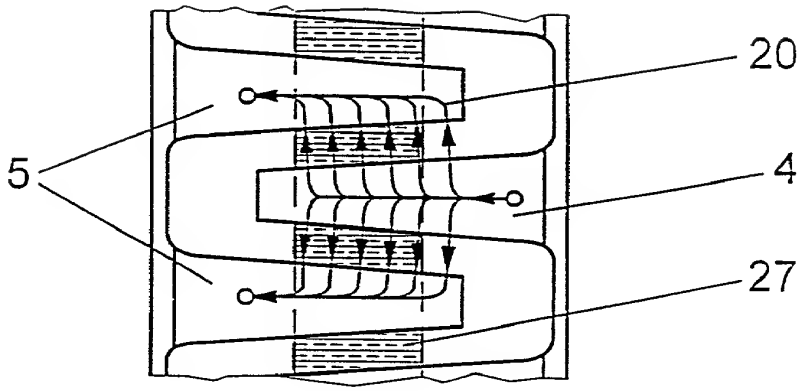

Fig. 5

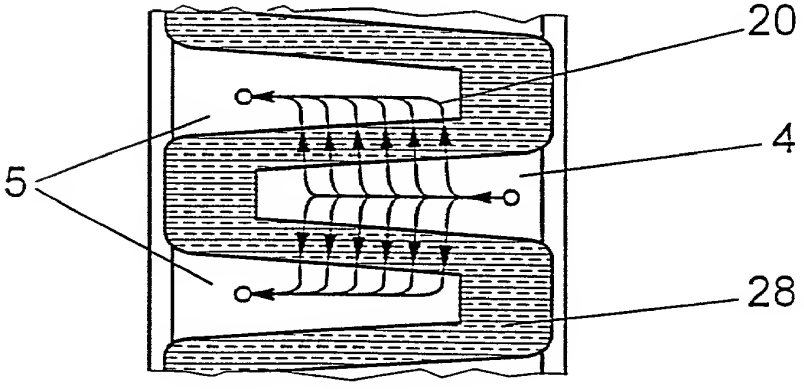

Fig. 6

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COMBINED DECLARATION AND POWER OF ATTORNEY

(Original, Design, National Stage of PCT, Supplemental)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☐ original
- ☐ design
- ☐ supplemental
- ■ National Stage of PCT
- ☐ divisional (see added page)
- ☐ continuation (see added page)
- ☐ continuation-in-part (see added page)

INVENTORSHIP IDENTIFICATION

My/our residence, post office address and citizenship is/are as stated below next to my/our name. I/We believe that the named inventor or inventors listed below is/are the original and first inventor or inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

ELECTROMAGNETIC HYSTERESIS UNIT

SPECIFICATION IDENTIFICATION

The specification of which: (complete (a), (b) or (c))

(a) ☐ is attached hereto.

(b) ☐ was filed on _____ as
☐ Serial No. _____ or
☐ Express Mail No. _____ as Serial No. (not yet known) and was amended on _____(if applicable).

(c) ■ was described and claimed in PCT International Application No. PCT/EP99/09231 filed on November 27, 1999 and as amended under PCT Article 19 on _____ (if any).

(d) ☐ amended on _____

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name(s) and registration number(s))

Anthony G. M. Davis	Registration No. 27,868
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Scott A. Daniels	Registration No. 42,462

☐ Attached as part of this Declaration and Power of Attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

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ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to be material to patentability of this application as defined in § 1.56 of Title 37 of the Code of Federal Regulations.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NO.	DATE OF FILING (day,month,year)	PRIORITY CLAIMED UNDER 37 USC 119
Fed. Rep. of Germany	**198 56 224.1**	**(04.12.98) 04 December 1998**	☒ YES NO
Fed. Rep. of Germany	**199 17 667.1**	**(19.04.99) 19 April 1999**	☒ YES NO
			YES NO
			YES NO
			YES NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

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Inventor's signature _____ Date 26.02.2001

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Inventor's signature _____Date _____

Country of Citizenship _____

Residence _____

Post Office Address _____

Full name of **fourth** joint inventor (if any)_____

Inventor's signature _____Date _____

Country of Citizenship _

Residence ____

Post Office Address __

Full name of **fifth** joint inventor (if any)_____

Inventor's signature _____Date _____

Country of Citizenship _

Residence ____

Post Office Address __

Full name of **sixth** joint inventor (if any)_____

Inventor's signature _____Date _____

Country of Citizenship _

Residence ____

Post Office Address __

Full name of **seventh** joint inventor (if any)_____

Inventor's signature _____Date _____

Country of Citizenship _

Residence _____

Post Office Address __